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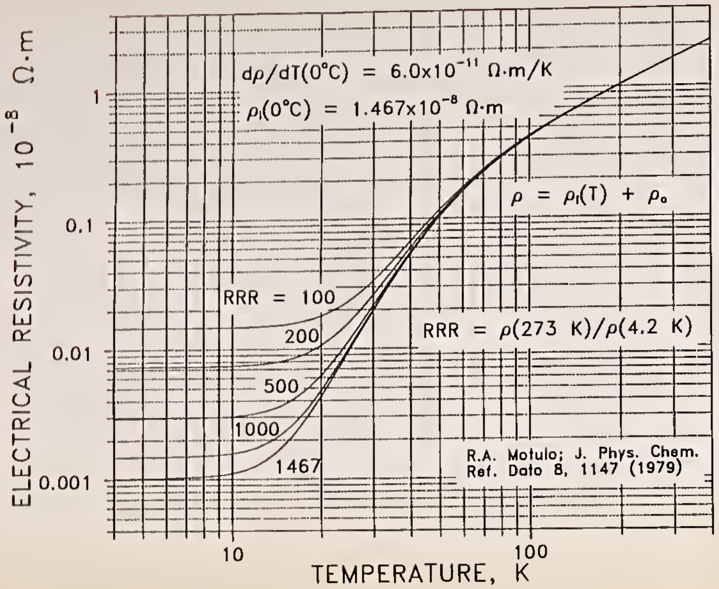
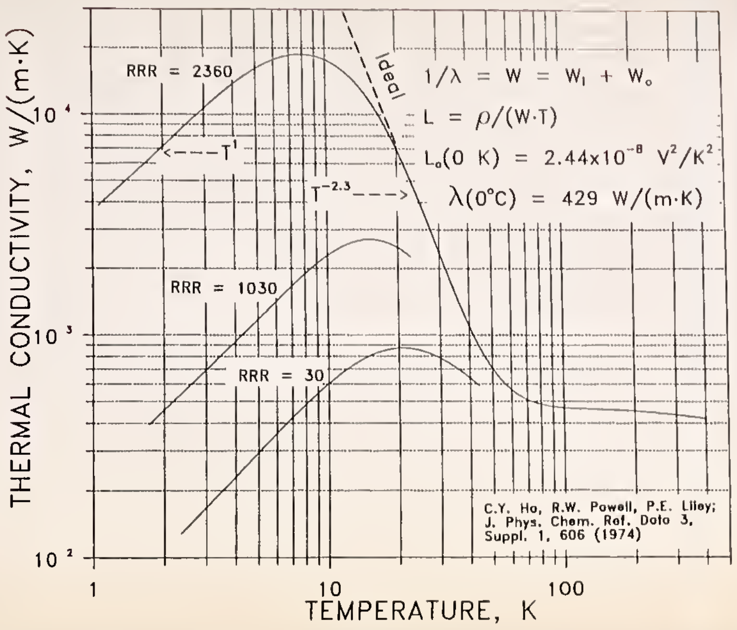
CRYOGENIC PROPERTIES OF SILVER



R.A. Matula; J. Phys. Chem. Ref. Data 8, 1147 (1979)

Chart Prepared by:

David R. Smith and F.R. Fickett
National Institute of Standards and
Technology
Boulder, Colorado

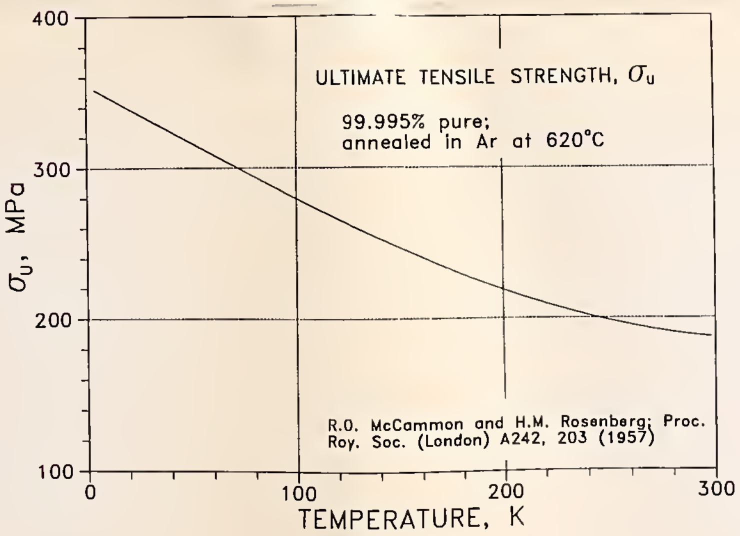


C.Y. Ho, R.W. Powell, P.E. Liley; J. Phys. Chem. Ref. Data 3, Suppl. 1, 606 (1974)

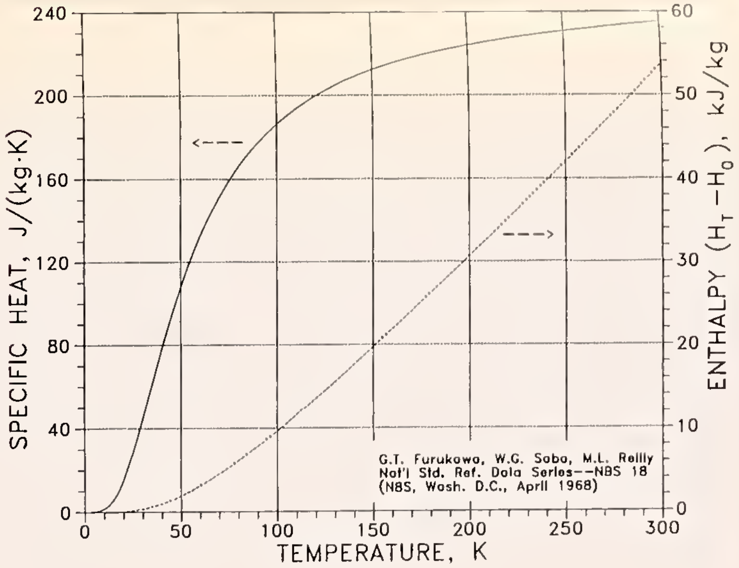
Change in Resistivity of Ag, per Atomic Percent of Alloying Element 18° C, nΩ·m/(at%)

As	Au	Bi	Cd	Cu	Ga	Ge	Hg
84.6	3.8	73	3.82	0.68	55.2	55.2	7.9
In	**Pb**	**Pd**	**Pt**	**Sn**	**Sn**	**Ti**	**Zn**
17.8	46.4	4.36	15.9	72.6	43.2	22.7	6.2

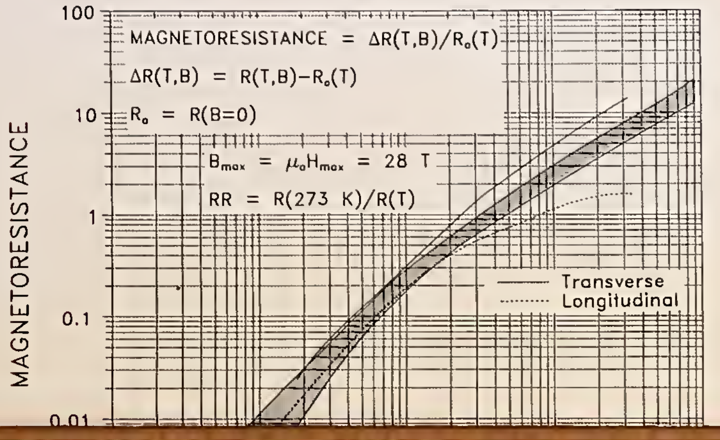
J.O. Linde, Annalen der Physik,
5 Folge, **15,** 239 (1932)

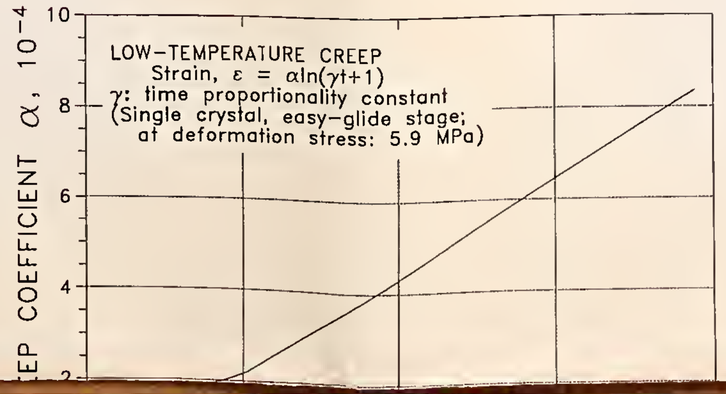


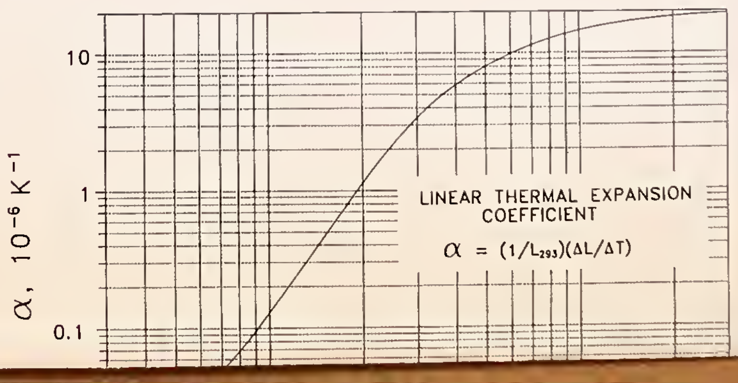
R.O. McCammon and H.M. Rosenberg; Proc. Roy. Soc. (London) A242, 203 (1957)

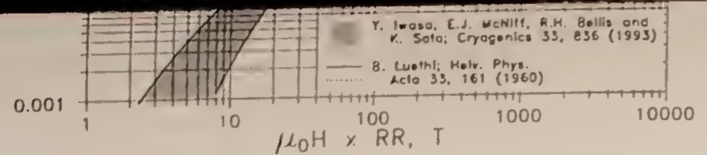


G.T. Furukawa, W.G. Saba, M.L. Reilly Nat'l Std. Ref. Data Series--NBS 18 (NBS, Wash. D.C., April 1968)



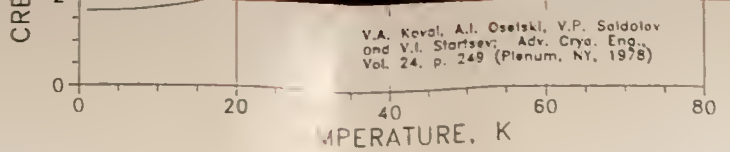




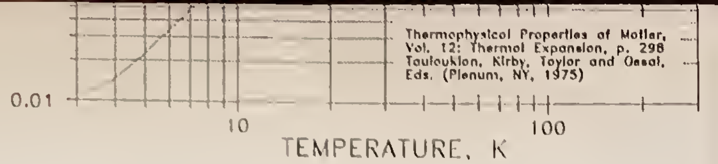


▨ Y. Iwasa, E.J. McNiff, R.H. Bellis and K. Sato; Cryogenics 33, 836 (1993)

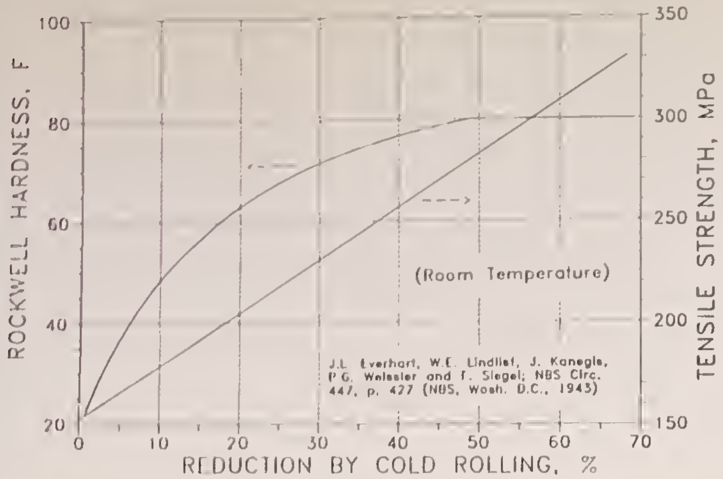
— B. Luethi; Helv. Phys. Acta 33, 161 (1960)



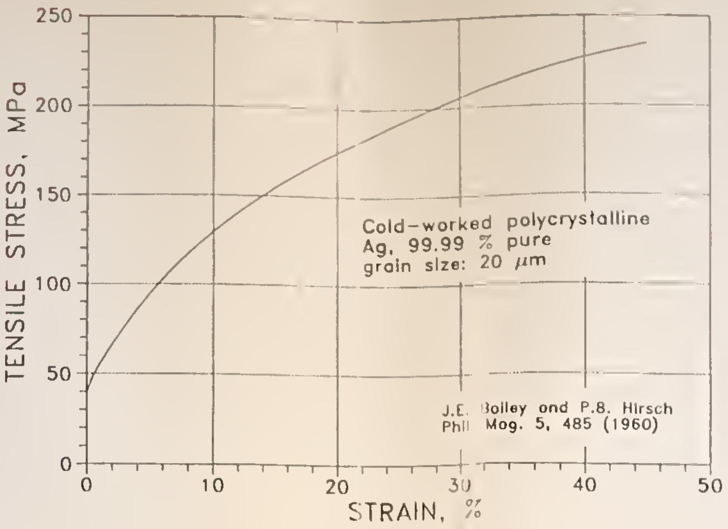
V.A. Koval, A.I. Osetski, V.P. Soldolov and V.I. Startsev; Adv. Cryo. Eng., Vol. 24, p. 249 (Plenum, NY, 1978)



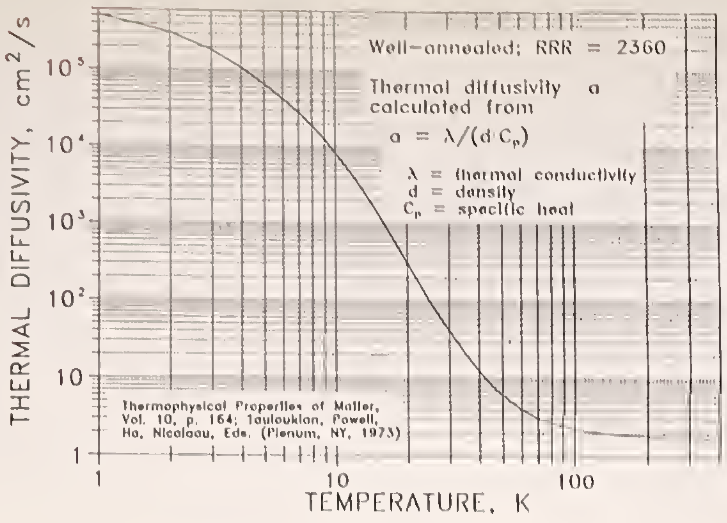
Thermophysical Properties of Matter, Vol. 12: Thermal Expansion, p. 298 Touloukian, Kirby, Taylor and Desai, Eds. (Plenum, NY, 1975)



J.L. Everhart, W.E. Lindlief, J. Kanegis, P.G. Weissler and F. Siegel; NBS Circ. 447, p. 427 (NBS, Wash. D.C., 1943)



J.E. Bailey and P.B. Hirsch Phil. Mag. 5, 485 (1960)

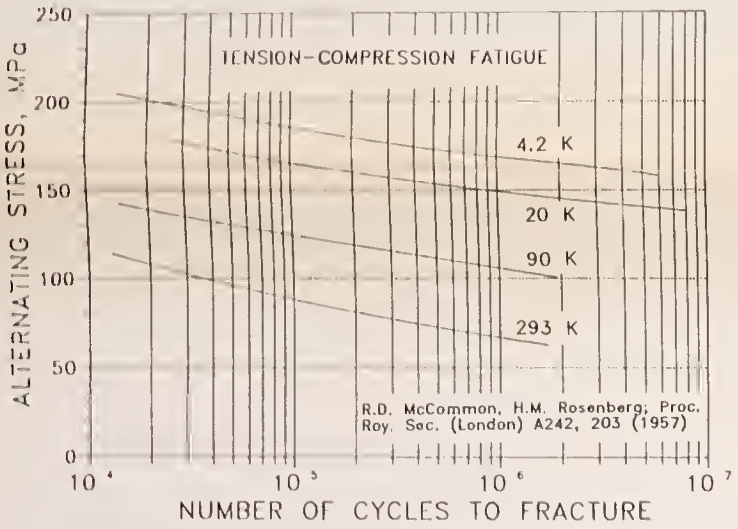


Thermal diffusivity a calculated from

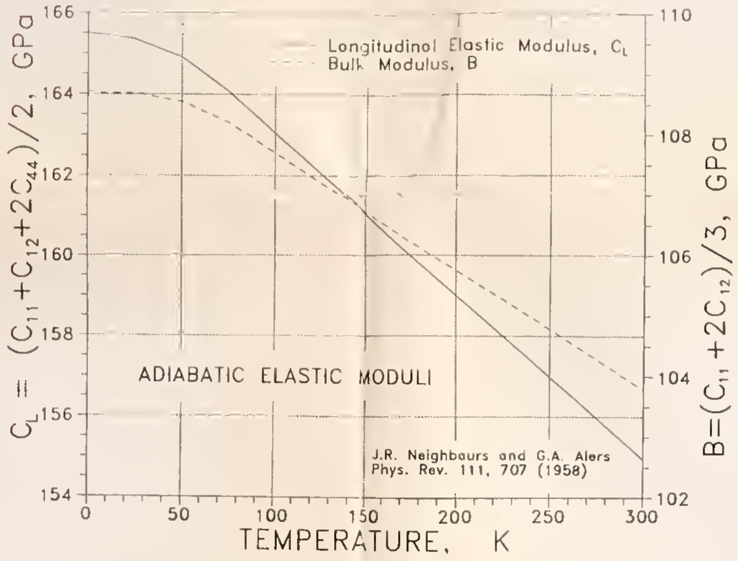
$a = \lambda/(d \cdot C_p)$

λ = thermal conductivity
d = density
C_p = specific heat

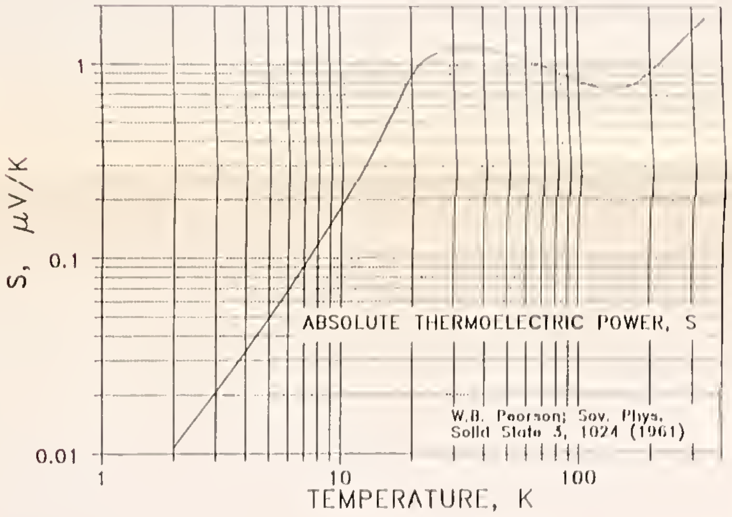
Thermophysical Properties of Matter, Vol. 10, p. 164; Touloukian, Powell, Ho, Nicolaou, Eds. (Plenum, NY, 1973)



R.D. McCammon, H.M. Rosenberg; Proc. Roy. Soc. (London) A242, 203 (1957)



J.R. Neighbours and G.A. Alers Phys. Rev. 111, 707 (1958)



W.B. Pearson; Sov. Phys. Solid State 3, 1024 (1961)

CONVERSION FACTORS and CONSTANTS		
K	= °C + 273.15	= (°F − 32)/1.8 + 273.15
1 J	= 0.239 cal	= 9.480×10^{-4} Btu
1 W/(m·K)	= 2.39×10^{-3} cal/(s·cm·°C)	= 0.578 Btu/(h·ft·°F)
1 J/(kg·K)	= 2.39×10^{-4} cal/(g·°C)	= 2.39×10^{-4} Btu/(lb$_m$·°F)
1 m²/s	= 10^4 cm²/s	= 10.76 ft²/s
1 Pa	= 10 dyne/cm²	= 1.45×10^{-4} lb$_f$/in²
1 T	= 10^4 G	
μ_o	= $4\pi \times 10^{-7}$ H/m	
1 m³/kg	= 79.58 emu/g	(Magnetic Susceptibility)
1 (SI)	= 7.958×10^{-2} emu/cm³	(Magnetic Susceptibility)

PHYSICAL and CHEMICAL PROPERTIES of SILVER (Ag: Argentum)

Atomic Number, Z	47	Melting Point	961.93°C
Atomic Mass, A	107.8682 u	Density (20°C)	10.492 g/cm³
Isotopes (A = 107)	106.9051 u (51.84%)	(0 K)	10.63 g/cm³
(A = 109)	108.9048 u (48.16%)	Debye Temperature	205 K (0 K) 215 K (20°C)
Atomic Diameter	0.2883 nm	Thermoelec. pwr.	1.35 μV/K (20°C)
Electron. Structure	[Kr] $4d^{10}$ $5s^1$	Elec. Resistivity	0.0147 μΩ·m (0°C)
Valence States	1, 2	Elastic Constants (0°C)	C_{11} = 131.5 GPa C_{12} = 97.33 GPa C_{44} = 51.1 GPa
Crystal Structure	face − centered cubic, Fm3m		
Lattice spacing, a_o	0.4078 nm (20°C)		
Electrochemical Potential	0.798 V ($Ag^+ + e^- \rightleftarrows Ag$)	Elastic Modulus	78.89 GPa (293 K) 87.02 GPa (0 K)
Ionization Potentials	7.574 V (I) 21.960 V (II) 36.10 V (III)	Poisson Ratio	0.37 (293 K)
		Hall Coefficient: (290 K)	-9.0×10^{-11} m³/(A·s)
		(20 K)	-10.2×10^{-11} m³/(A·s)
Cohesive Energy (25°C)	2.96 eV/atom, 285.8 kJ/mol	Fermi Energy	5.52 eV = 8.84×10^{-19} J
Magnetic (mass) Susceptibility	-2.300×10^{-9} m³/kg (4.2 K) -2.27×10^{-9} m³/kg (295 K)	Fermi Surface	Spherical, with necks at (111)

Constants: u = ^{12}C/12 = 1.66×10^{-27} kg
1 eV = 1.602×10^{-19} J
N_A = 6.023×10^{23} molecules per mole

PROPERTIES OF CRYOGENIC FLUIDS

		Liquid at normal b.p.				Vapor at 10^5 Pa (1 atm)			
FLUID	Atomic mass u	Temp. K	Density mol/L	Enthalpy J/mol	Spec. Ht. J/(mol·K)	Temp. K	Density mol/L	Enthalpy J/mol	Spec. Ht. J/(mol·K)
Helium	4.0026	4.222	31.20	−21.0	21.10	4.222 20.27 27.09 77.36 90.20 273.15	4.226 0.601 0.449 0.157 0.135 0.045	62 419 562 1609 1876 5679	36.73 21.01 20.91 20.80 20.79 20.79
Hydrogen (para)	2.0159	20.27	35.12	−516	19.49	20.27 27.09 77.36 90.20 273.15	0.664 0.470 0.158 0.135 0.045	382 539 1632 1944 7657	24.68 22.14 23.36 25.38 30.36
Neon	20.180	27.09	59.71	−1203	36.63	27.09 77.38 90.20 273.15	0.475 0.156 0.135 0.045	527 1602 1870 5678	28.5 20.9 20.9 20.8
Nitrogen	28.134	77.36	28.66	−3401	57.79	77.36 90.20 273.15	0.165 0.139 0.045	2164 2559 7934	31.45 30.43 29.15
Oxygen	31.999	90.20	35.66	−4263	54.22	90.20 273.15	0.140 0.045	2535 7937	31.35 29.33

NIST Standard Database 12: "NIST Thermophysical Properties of Pure Fluids" (Version 3.0), D.G. Friend (NIST, Gaithersburg, MD; 1992)

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